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Earned Value Data Usage Techniques

Presented by
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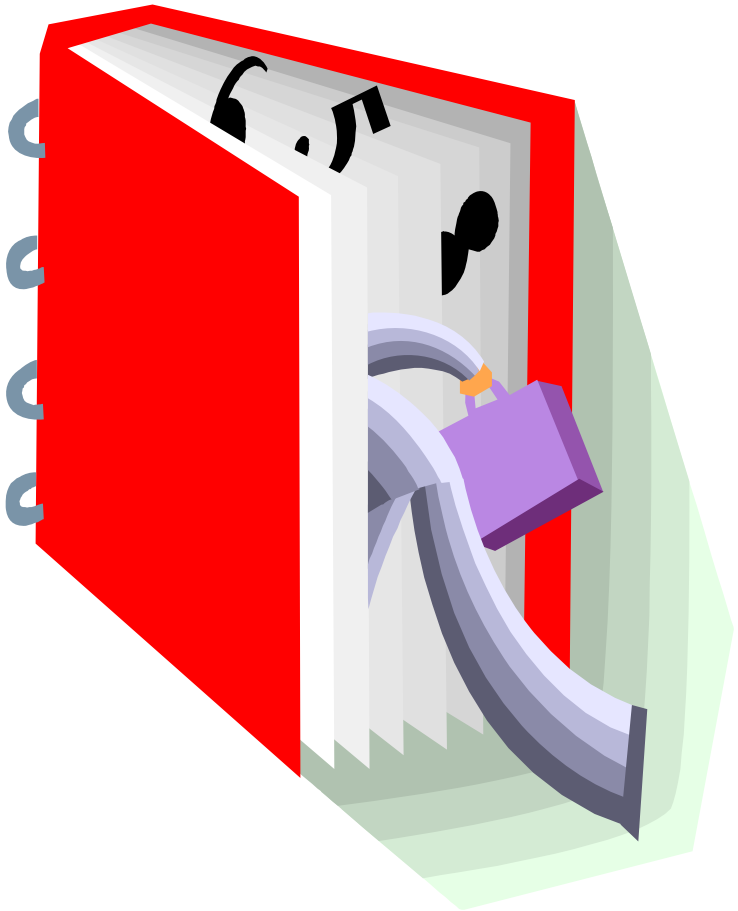
Agenda

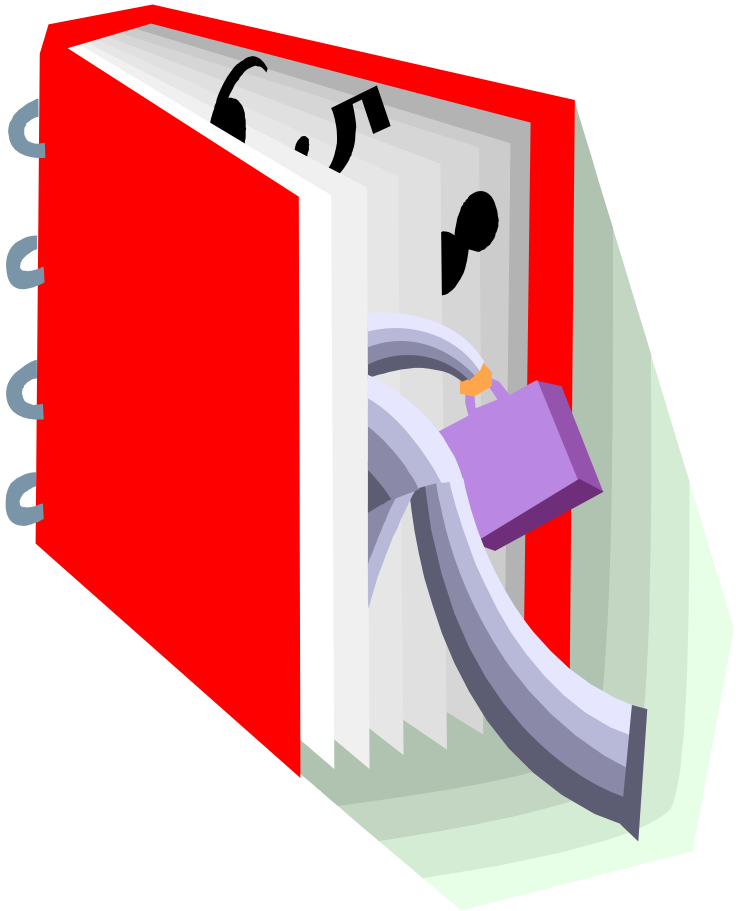
- Performance Measurement Data Elements
- Data Reporting & Variance Analysis
- Analyzing Labor & Material Variances
- Indices and EAC Formulae, their Benefits and Drawbacks
- Use of Graphs & Trend Information



Performance Measurement Data Elements

Performance Measurement Data Elements

- **Budget or plan or Budgeted Cost for Work Scheduled (BCWS)**
- **Earned, Earned Value, value of work accomplished or Budgeted Cost for Work Performed (BCWP)**
- **Actuals, Actual Costs or Actual Cost of Work Performed**



Data Reporting & Variance Analysis

Classification (when filled in)

Contract Performance Report
Format 1 - Work Breakdown Structure

Dollars In _____

Form Approved
OMB No. 0704-0188

1. Contractor	2. Contract		3. Program	4. Report Period
a. Name	a. Name		a. Name	a. From (YYYY/MM/DD)
b. Location (Address & Zip Code)	b. Number		b. Phase	
	c. Type	d. Share Ratio	c. EVMS Acceptance No Yes (YYYY/MM/DD)	b. To (YYYY/MM/DD)

5. Contract Data

a. Quantity	b. Negotiated Cost	c. Est. Cost of Auth. Unpriced Work	d. Target Profit/Fee	e. Target Price	f. Estimated Price	g. Contract Ceiling	h. Estimated Contract Ceiling

6. Estimated Cost at Completion				7. Authorized Contractor Representative	
	Management Estimate at Completion (1)	Contract Budget Base (2)	Variance (3)	a. Name (Last, First, Middle Initial)	b. Title
a. Best Case				c. Signature	d. Date Signed (YYYY/MM/DD)
b. Worst Case					
c. Most Likely					

8. Performance Data

Item	Current Period					Cumulative To Date					Reprogramming Adjustments			At Completion		
	Budgeted Cost		Actual Cost Work Performed	Variance		Budgeted Cost		Actual Cost Work Performed	Variance							
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost	Cost Variance	Schedule Variance	Budget	Budgeted	Estimated	Variance
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12a)	(12b)	(13)	(14)	(15)	(16)
a. Work Breakdown Structure Element																
b. Cost of Money																
c. Gen. & Admin.																
d. Undistributed Budget																
e. Subtotal (Performance Measurement Baseline)																
f. Management Reserve																
g. TOTAL																
9. Reconciliation To Contract Budget Base																
a. Variance Adjustment																
b. Total Contract Variance																

DD FORM 2734/1, MAR 05

Classification (when filled in)

Classification (When filled in)

Contract Performance Report
Format 3 – Baseline

Dollars In _____

Form Approved
OMB No. 0704-0188

1. Contractor	2. Contract		3. Program	4. Report Period
a. Name	a. Name		a. Name	a. From (YYYY/MM/DD)
b. Location (Address & Zip Code)	b. Number		b. Phase	b. To (YYYY/MM/DD)
	c. Type	d. Share Ratio	c. EVMS Acceptance No Yes (YYYY/MM/DD)	

5. Contract Data

a. Original Negotiated Cost	b. Negotiated Contract Changes	c. Current Negotiated Cost (a. + b.)	d. Estimated Cost Of Authorized Unpriced work	e. Contract Budget Base (c. + d.)	f. Total Allocated Budget	g. Difference (e. – f.)

h. Contract Start Date (YYYY/MM/DD)	i. Contract Definitization Date (YYYY/MM/DD)	j. Planned Completion Date (YYYY/MM/DD)	k. Contract Completion Date (YYYY/MM/DD)	l. Estimated Completion Date (YYYY/MM/DD)

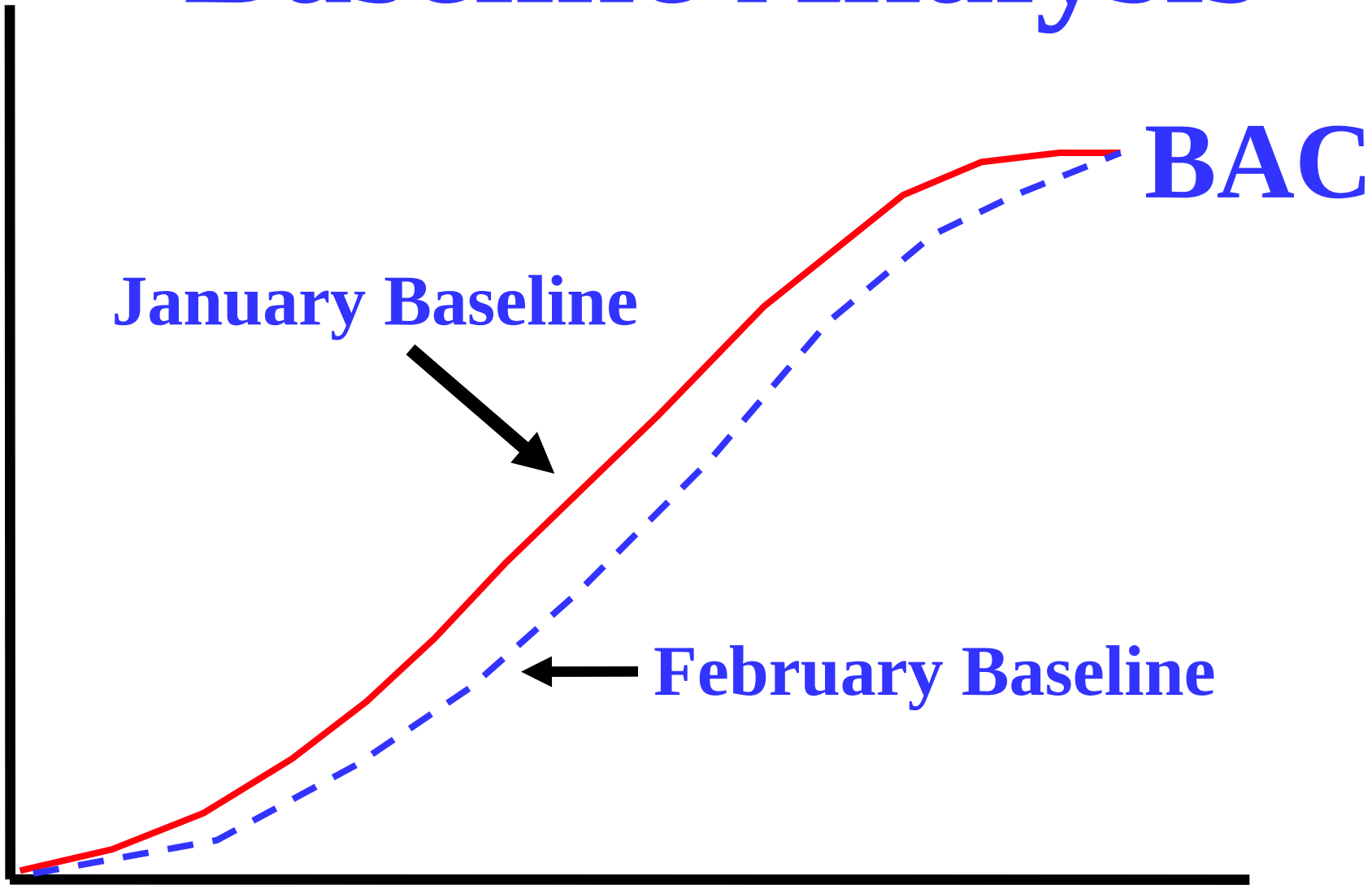
6. Performance Data

Item	BCWS Cumulative To Date	BCWS For Report Period	Budgeted Cost For Work Scheduled (BCWS) *(Non-Cumulative)*											Undis-tributed Budget	Total Budget
			Six Month Forecast						(Enter Specified Periods)						
			+ 1	+ 2	+ 3	+ 4	+ 5	+ 6							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
a. Performance Measurement Baseline (Beginning of Period)															
b. Baseline Changes Authorized During Report Period															
c. Performance Measurement Baseline (End of Period)															
7. Management Reserve															
8. Total															

DD FORM 2734/3, MAR 05

Classification (When filled in)

Baseline Analysis



Contract Performance Report
Format 5 – Explanations And Problem Analyses

Form Approved
OMB No. 0704-0188

1. Contractor	2. Contract		3. Program	4. Report Period
a. Name	a. Name		a. Name	a. From (YYYY/MM/DD)
b. Location (Address & Zip Code)	b. Number		b. Phase	b. To (YYYY/MM/DD)
	c. Type	d. Share Ratio	c. EVMS Acceptance No Yes (YYYY/MM/DD)	

5. Evaluation

Summary Analysis

Summary of Overall Contract Variances
Differences between EAC's (Blocks 6.a, 6.b, 6.c, or Block 8.15)
Changes in Undistributed Budget
Changes in Management Reserve
Significant timephasing shifts in Baseline (BCWS) (Format 3)
Significant timephasing shifts or Overall Changes in Forecasted Staffing (Format 4)
Discussion of Over Target Baseline and/or Over Target Schedule incorporation

Analysis of Significant Variances: (identify and describe each)

Type and Magnitude of Variance
Explanation of Significant Reasons
Effect on Immediate Task
Effect on Total Contract
Corrective Actions Taken or Planned

Variance Analysis Report

Title: Condensing System
Number: 62-091-1-82-6

Report Period: July

($000)	Budget	Earned Value	Actual Cost	Schedule Variance	VAR %	Cost Variance	VAR %
Current	30	20	22	(10)	(33)	(2)	(10)
Cumulative	380	300	330	(80)	(21)	(30)	(10)

1,200	1,300	(100)
Budget At Complete	Estimate At Complete	Variance At Complete

Problem Analysis

Impact

Corrective Action Plan

Estimate At Completion Justification

Control Account Manager

_____ Signature _____ Date

_____ Title

Approvals

_____ Signature _____ Date

_____ Title

Narrative Reports

Areas usually not adequately addressed:

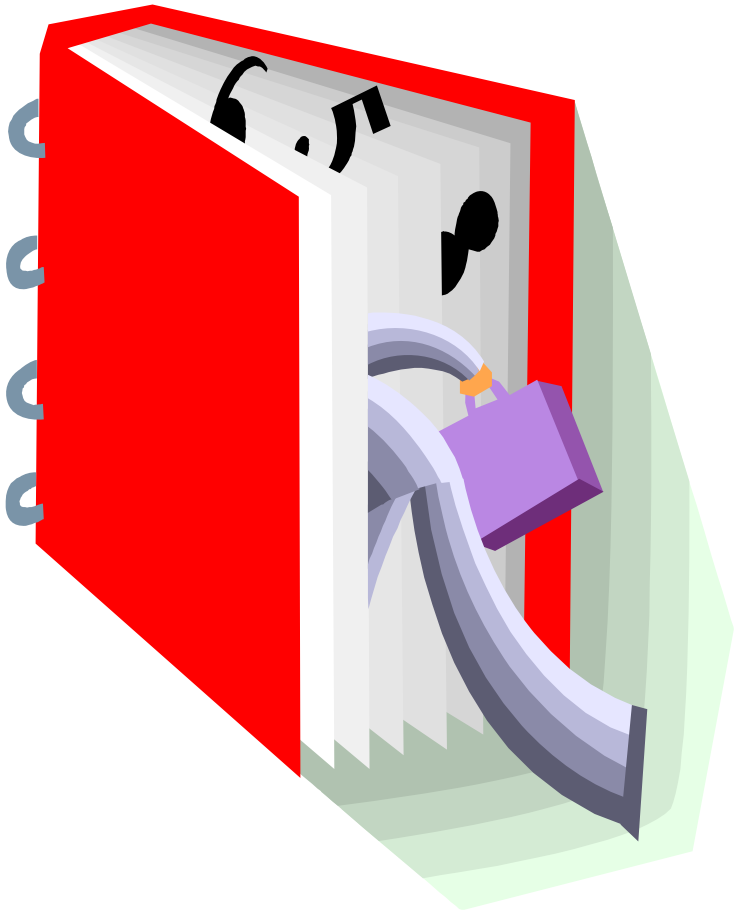
- Labor rate and efficiency
- Material price and usage
- Overhead base/rate/volume
- EAC justification when EAC not revised
- Corrective action “get well” dates
- Impacts of previous corrective actions

Inadequate Narratives

- **Overrun due to actuals being greater than Earned Value**
- **Behind schedule due to less work being accomplished than was planned**
- **Behind schedule since entire program is behind schedule**

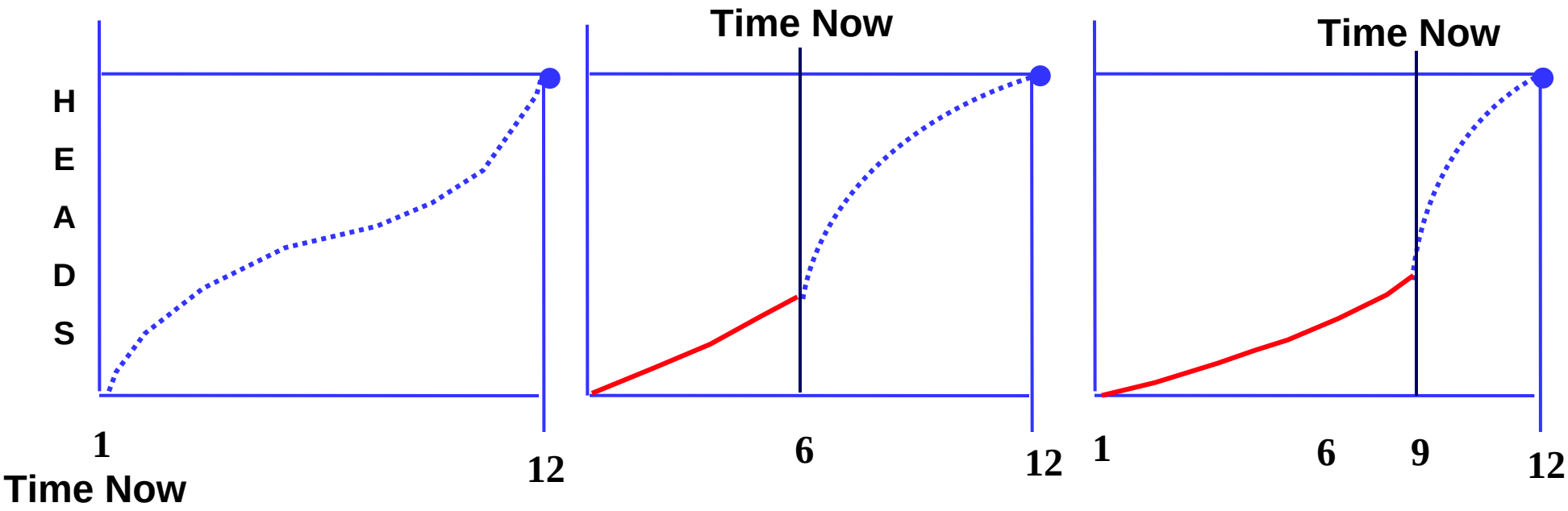
Inadequate Narratives

- **Overtime will be used to regain schedule. No cost impact. (and no explanation of why no cost impact)**
- **Underrun due to positive labor efficiency, will develop corrective action plan next month. (?????)**
- **Overrun due to tasks being underbid**

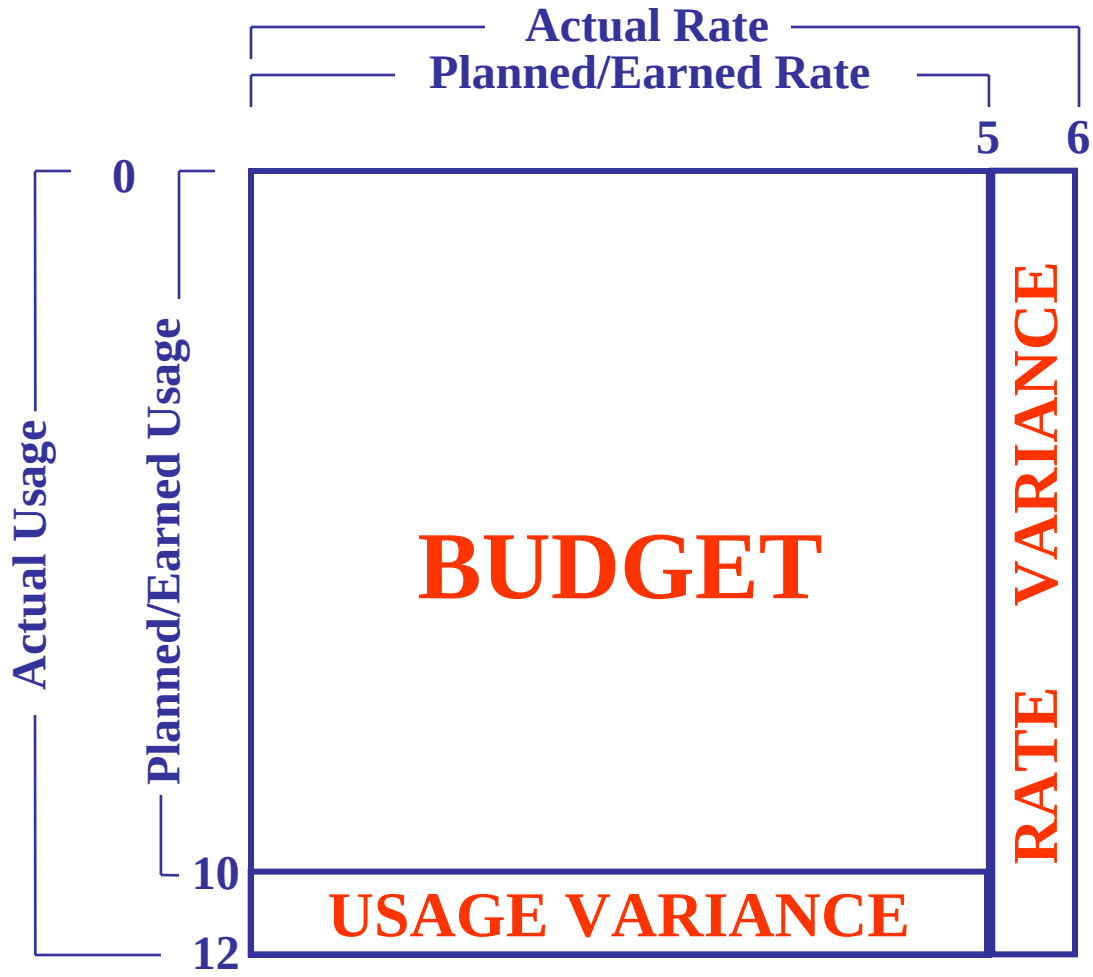


Analyzing Labor & Material Variances

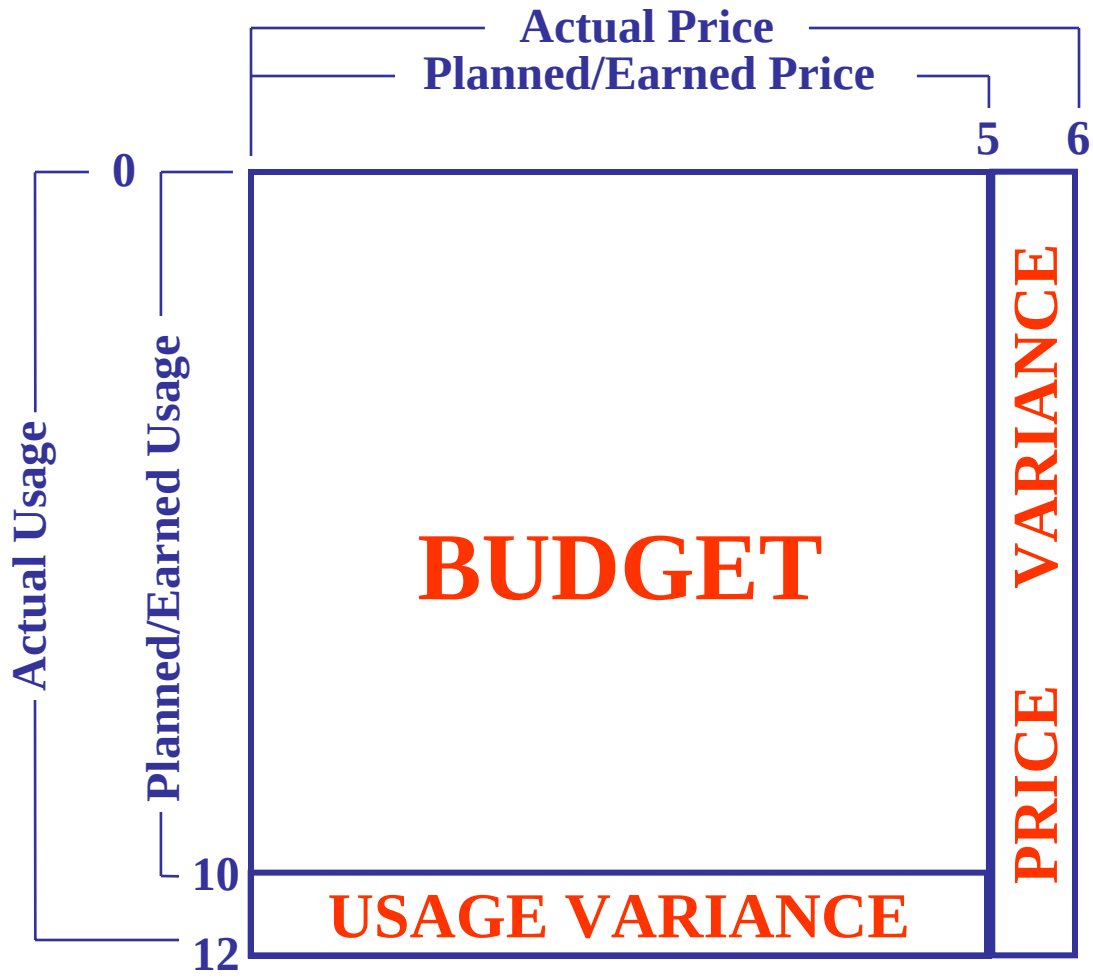
Analysis Of Manpower


H
E
A
D
S
1
Time Now
12
Time Now
6
12
Time Now
1
6
9
12
= Actuals
= Forecast

Labor Cost Variance Components



Material And Equipment Cost Variance Components



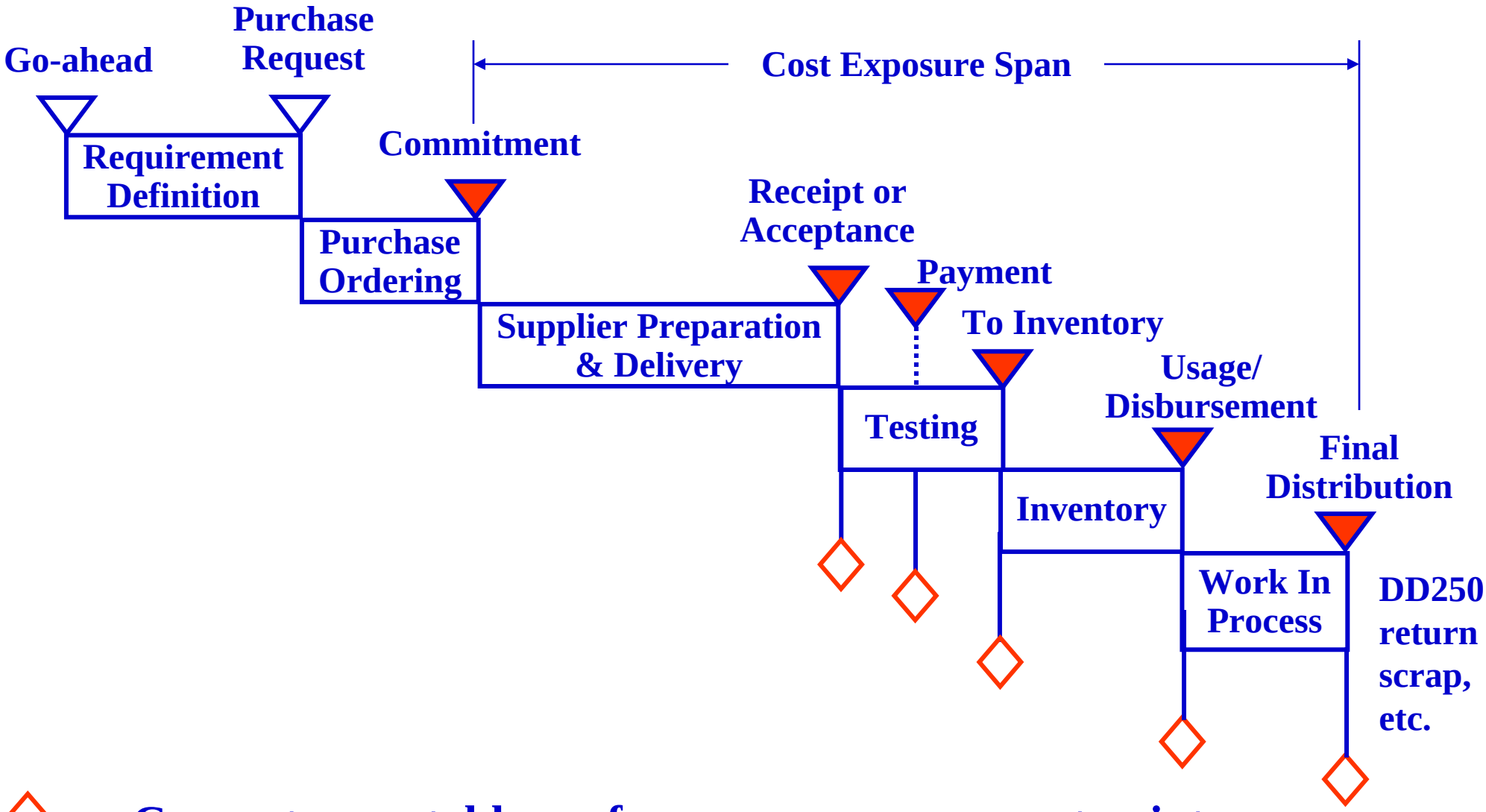
Material Price Variances

- **When should Price Variance first be determined?**
  - ➔ **At contract award**
  - ➔ **Upon completion of priced bill of material**
  - ➔ **Upon issuance of purchase request**

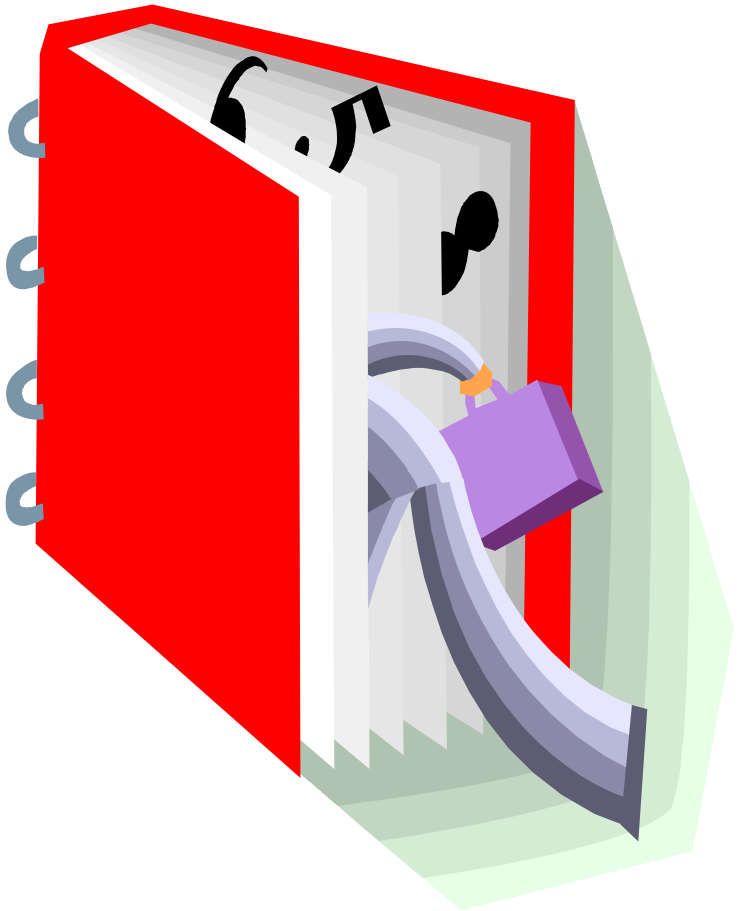
>> UPON ISSUANCE OF PURCHASE ORDER <<

  - ➔ **Upon receipt of material invoice**
  - ➔ **Upon taking Earned Value and actuals**
  - ➔ **Upon payment of material invoice**

Material Measurement

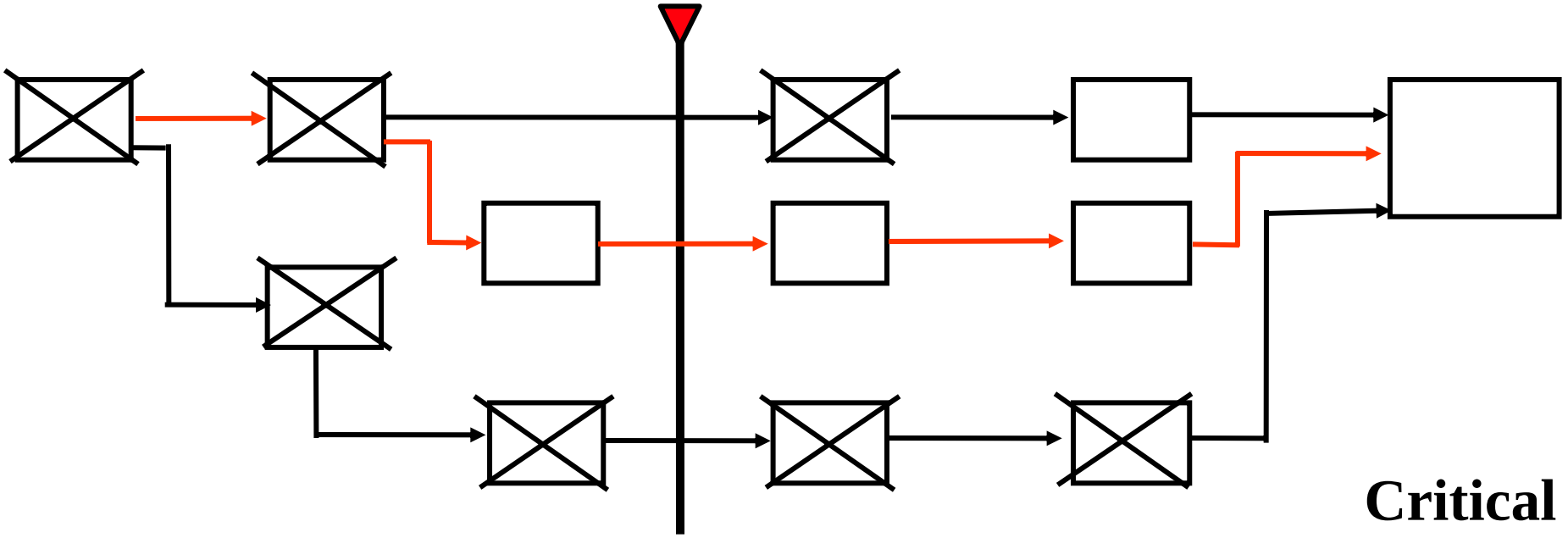


◇ = Current acceptable performance measurement points



Indices and EAC Formulae, their Benefits and Drawbacks

Performance Measurement Data Concern



Time Now

Critical Path

Budget 7000

Earned Value 7000

> "0" Schedule Variance

Schedule Performance Index (SPI)

$$SPI = \frac{\text{Earned}}{\text{Budget}}$$

Schedule Performance Index (SPI)

SPI = Earned / Budget = 70,000 / 60,000 = 1.17

SPI Of 1.17: **Indication of ahead of schedule. For every $1.00 worth of work that was planned, $1.17 worth of work was accomplished.**

Note: Work that was accomplished may not be the same work that was planned to be accomplished.

Cost Performance Index (CPI)

$$CPIe = \frac{\text{Earned Value}}{\text{Actual Cost}} = \frac{70{,}000}{80{,}000} = 0.875$$

OR

$$CPIp = \frac{\text{Actual Cost}}{\text{Earned Value}} = \frac{80{,}000}{70{,}000} = 1.142$$

"To Complete" Performance Index (TCPI)

$$TCPI = \frac{\text{Budget for remaining work}}{\text{Estimate for remaining work}} = \frac{\text{BAC - Earned Value to date}}{\text{EAC - Actual cost to date}}$$

$$TCPI = \frac{210{,}000-70{,}000}{210{,}000-80{,}000} = \frac{140{,}000}{130{,}000} = 1.076$$

Performance Indices Comparison

CPI_E	TCPI
Performance to Date	Projected Performance
0.875	1.076
For every $1.00 of actual cost we earned $0.875 worth of work planned	For every $1.00 of cost we estimate to earn $1.076 worth of work planned to finish on EAC

Schedule Variance Percentage (SV%)

$$SV\% = \frac{SV}{BCWS} \times 100 = \frac{(6{,}000)}{76{,}000} \times 100 = (7.9\%)$$

Cost Variance Percentage (CV%)

$$CV\% = \frac{CV}{BCWP} \times 100$$

$$= \frac{(10{,}000)}{70{,}000} = (0.14) \times 100 = (14\%)$$

Variance At Completion Percentage (VAC%)

$$\text{VAC \%} = \frac{\text{VAC}}{\text{BAC}} \times 100 =$$

$$\frac{(20)}{150} \times 100 = (13.3)\ \%$$

Percent Complete
(in a budget sense)

Percent Complete =

Work Complete/Total Work =

BCWP/BAC x 100

- **For total contract, BAC should include Management Reserve and any summary level budgets**

Percent Scheduled

$$\text{Percent Scheduled} = \frac{\text{BCWS}}{\text{BAC}}$$

Percent of total work that was planned to have been accomplished to date

Percent Spent

(in a funding sense)

$$\text{Percent Spent} = \frac{\text{Money Spent To Date}}{\text{Total Expected Expenditures}} = \frac{\text{Actuals}}{\text{EAC}}$$

- The denominator should reflect the most likely representation of total expected expenditures (BAC or EAC)

Statistical Estimate At Completion (EAC)

$$EAC = Actuals_{CUM} + \frac{(BAC - Earned\ Value_{CUM})}{Performance\ Factor\ (PF)}$$

Effects Of Different Weighting On EAC 2

									Cum CPI		Weighted Cost & Schedule				CPI X SPI	
											wts each = 0.5		cst wt = 0.8 sch wt = 0.2			
	Budget	Earned	Actual	SV	CV	SPI	CPI	BAC	EAC 1	VAC 1	EAC 2	VAC 2	EAC 2	VAC 2	EAC 3	VAC
Example #1	100	85	93	-15	-8	0.85	0.91	1000	1094	-94	1130	-130	1108	-108	1271	-271
Example #2	100	115	107	15	8	1.15	1.07	1000	930	70	903	97	919	81	823	177
Example #3	100	100	100	0	0	1.00	1.00	1000	1000	0	1000	0	1000	0	1000	
Example #4	100	85	77	-15	8	0.85	1.10	1000	906	94	1014	-14	946	54	1052	-52
Example #5	100	115	123	15	-8	1.15	0.93	1000	1070	-70	972	28	1028	-28	946	54
Example #6	100	100	108	0	-8	1.00	0.93	1000	1080	-80	1043	-43	1065	-65	1080	-80
Example #7	100	100	92	0	8	1.00	1.09	1000	920	80	955	46	933	67	920	80
Example #8	100	115	115	15	0	1.15	1.00	1000	1000	0	938	62	974	26	885	115
Example #9	100	85	85	-15	0	0.85	1.00	1000	1000	0	1074	-74	1028	-28	1161	-161

EAC 2 Comparisons Example # 1

Budget	Earned	Actuals	SV	CV	SPI	CPI	BAC
100	85	93	(15)	(8)	0.85	0.91	1000

Cum CPI	EAC 1 = 1094	VAC 1 = (94)
Cst = .5/Sch = .5	EAC 2 = 1130	VAC 2 = (130)
Cst = .8/Sch = .2	EAC 2 = 1108	VAC 2 = (108)
CPI X SPI	EAC 3 = 1271	VAC 3 = (271)

EAC 2 Comparisons Example # 4

Budget	Earned	Actuals	SV	CV	SPI	CPI	BAC
100	85	77	(15)	8	0.85	1.10	1000

Cum CPI	EAC 1 = 906	VAC 1 = 94
Cst = .5/Sch = .5	EAC 2 = 1014	VAC 2 = (14)
Cst = .8/Sch = .2	EAC 2 = 946	VAC 2 = 54
CPI X SPI	EAC 3 = 1052	VAC 3 = (52)

EAC 2 Comparisons Example # 5

Budget	Earned	Actuals	SV	CV	SPI	CPI	BAC
100	115	123	15	(8)	1.15	0.93	1000

Cum CPI	EAC 1 = 1070	VAC 1 = (70)
Cst = .5/Sch = .5	EAC 2 = 972	VAC 2 = 28
Cst = .8/Sch = .2	EAC 2 = 1028	VAC 2 = (28)
CPI X SPI	EAC 3 = 946	VAC 3 = 54

6 Month Average CPI PF Calculation

$$PF = \left(\frac{\text{cum earned}_{\text{cur month}} - \text{cum earned}_{\text{cur month -6}}}{\text{cum actuals}_{\text{cur month}} - \text{cum actuals}_{\text{cur month -6}}} \right)$$

Projection based on the past six months of contract performance

Performance Factor PF Input

EAC = PF X (BAC – CUM EARNED)

User input PF

Example:

PF = 1.1 work remaining will overrun 10%
PF = .85 work remaining will underrun 15%

Projection based upon estimated cost efficiency for remaining work

Army MICOM EAC PF Calculation

PF = 6 month average CPI X cum SPI

Projection based on the past six months of contract performance and cumulative to date schedule performance

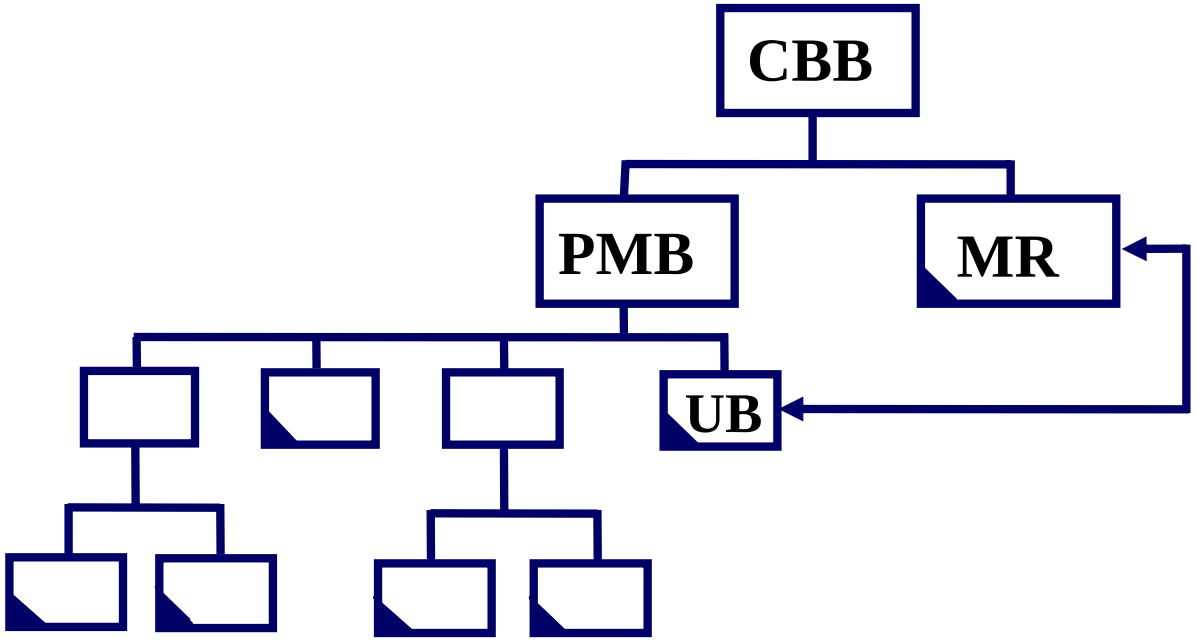
Statistical IEAC (s)

- **Advantages**

  - ➔ **Automated**
  - ➔ **Historical**
  - ➔ **Detail level EAC's summarized**

Statistical IEAC s Options

- **Statistical forecasts at Contract Budget Base (CBB) or Performance Measurement Baseline**



What Performance Factors are used for IEAC?

- **Bottom Line or Bottoms-Up (Summation of lowest level IEACs)**

Statistical IEAC For MR?

Assume:

CBB = 200

MR = 20

PMB = 180

If CPIe = .7

Statistical IEAC For MR?

$$\frac{\text{CBB}}{\text{CPIe}} = \frac{200}{.7} = 285.71$$

VERSUS

$$\frac{\text{PMB}}{\text{CPIe}} = \frac{180}{.7} = 257.14 + \text{MR } 20.00 = 277.14$$

Bottom Line Or Bottom-Up?

Bottom line: Calculates EAC based upon performance data (BCWS, BCWP, ACWP, BAC) at PMB or CBB

Bottoms up: Summation of lowest level EACs to PMB or CBB

Sample Calculations:

	Cumulative				Cum	
	BCWS	BCWP	ACWP	BAC	CPI	*EAC
3000	35	22	28	75	.7857	95.45
3100	15	12	13	25	.9230	27.08
3200	20	10	15	50	.6666	75.00
					Summation →	102.08

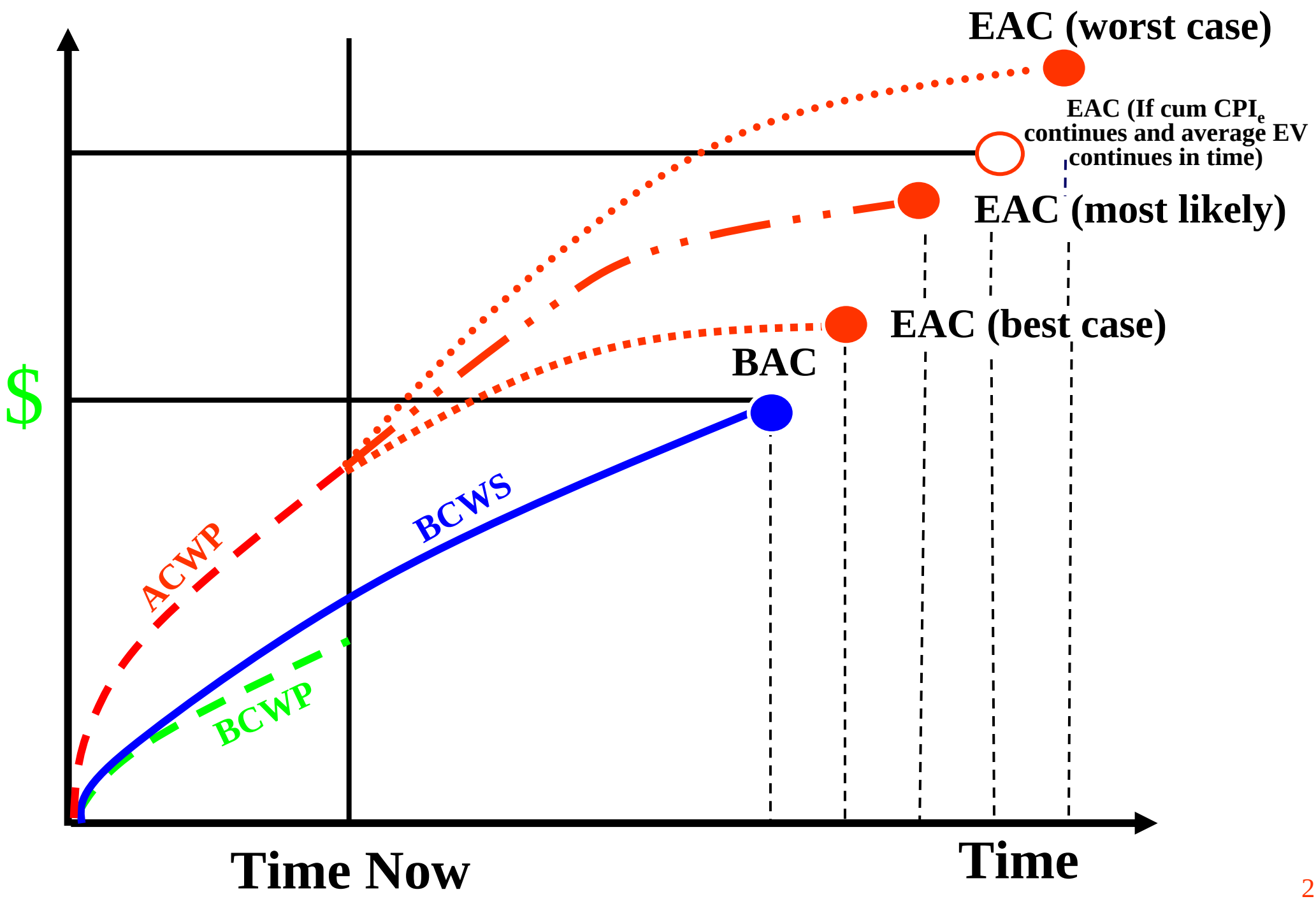
* EAC = BAC / Cum CPI

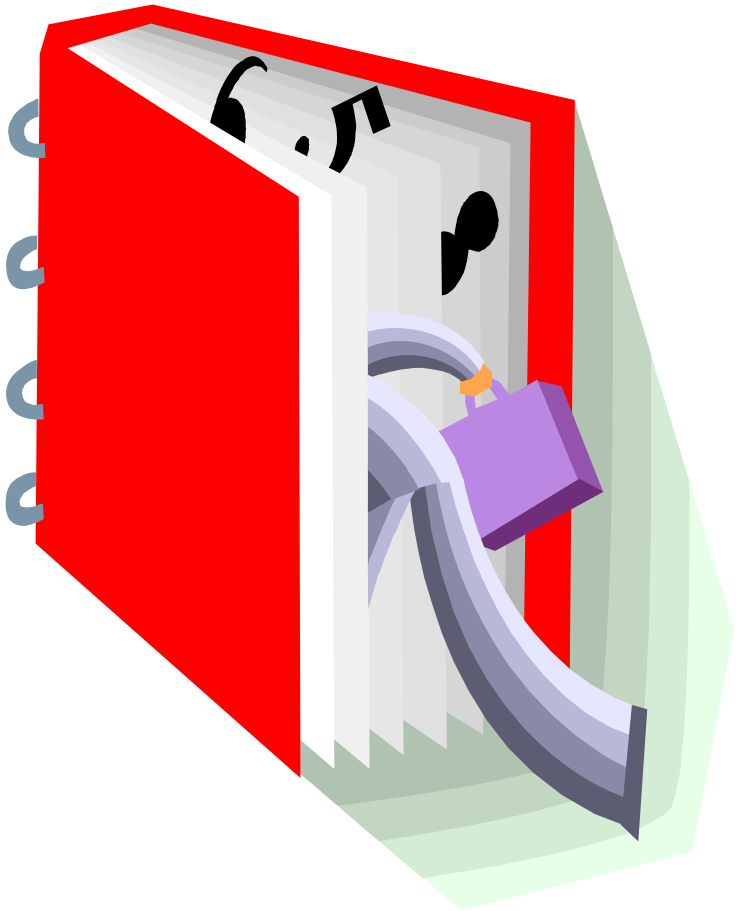
Bottom-Line

Delta $6.63 Or 6.9%

Customer Program Manager's Information Need

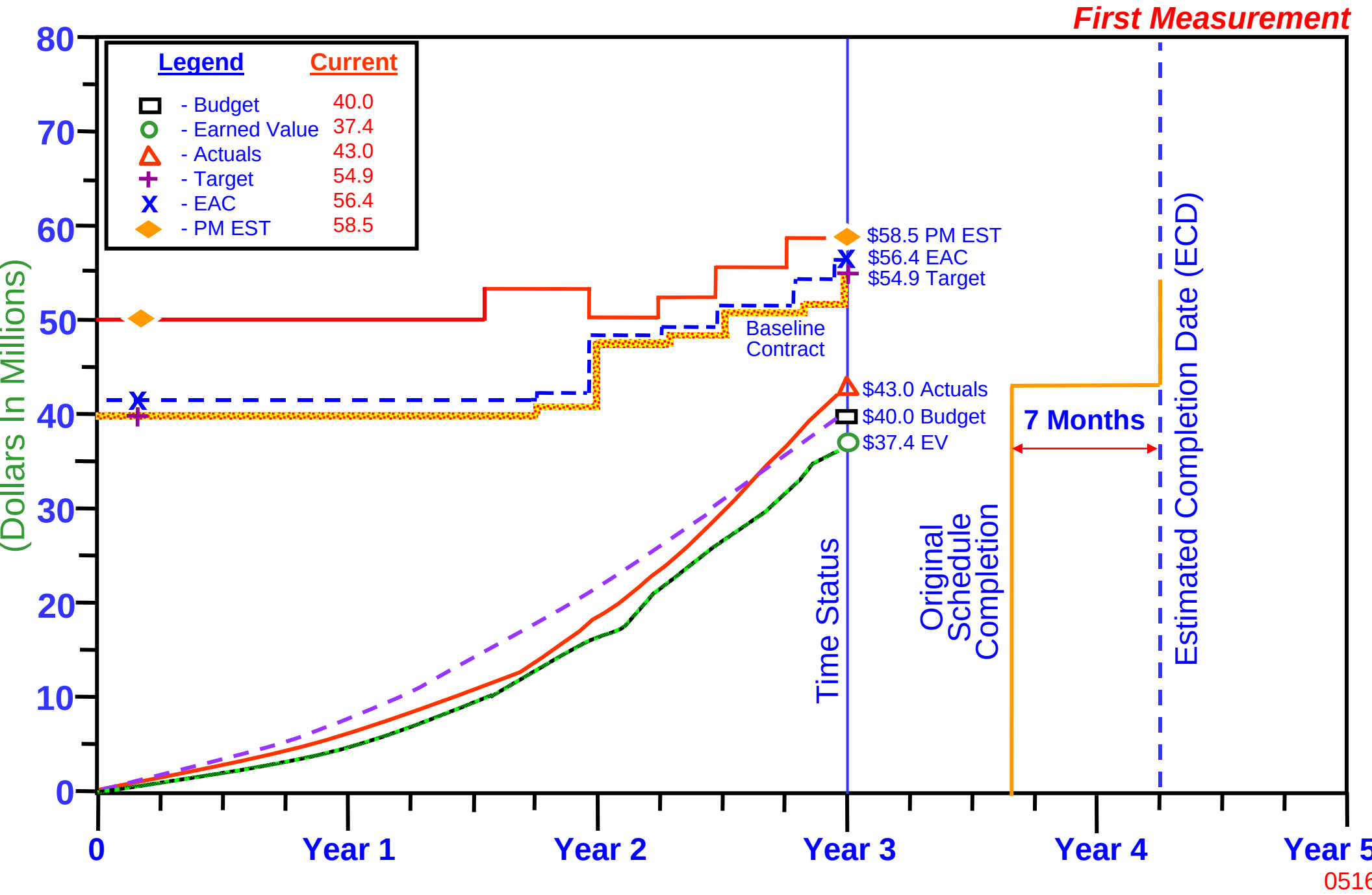
- **Estimated significant effort**
- **Contract Estimated Completion Date (ECD)**
- **Estimate at Completion (EAC)**


EAC (worst case)
EAC (If cum CPIe continues and average EV continues in time)
EAC (most likely)
EAC (best case)
BAC
$
ACWP
BCWS
BCWP
Time Now
Time



Use Of Graphs and Trend Information

Contract Performance



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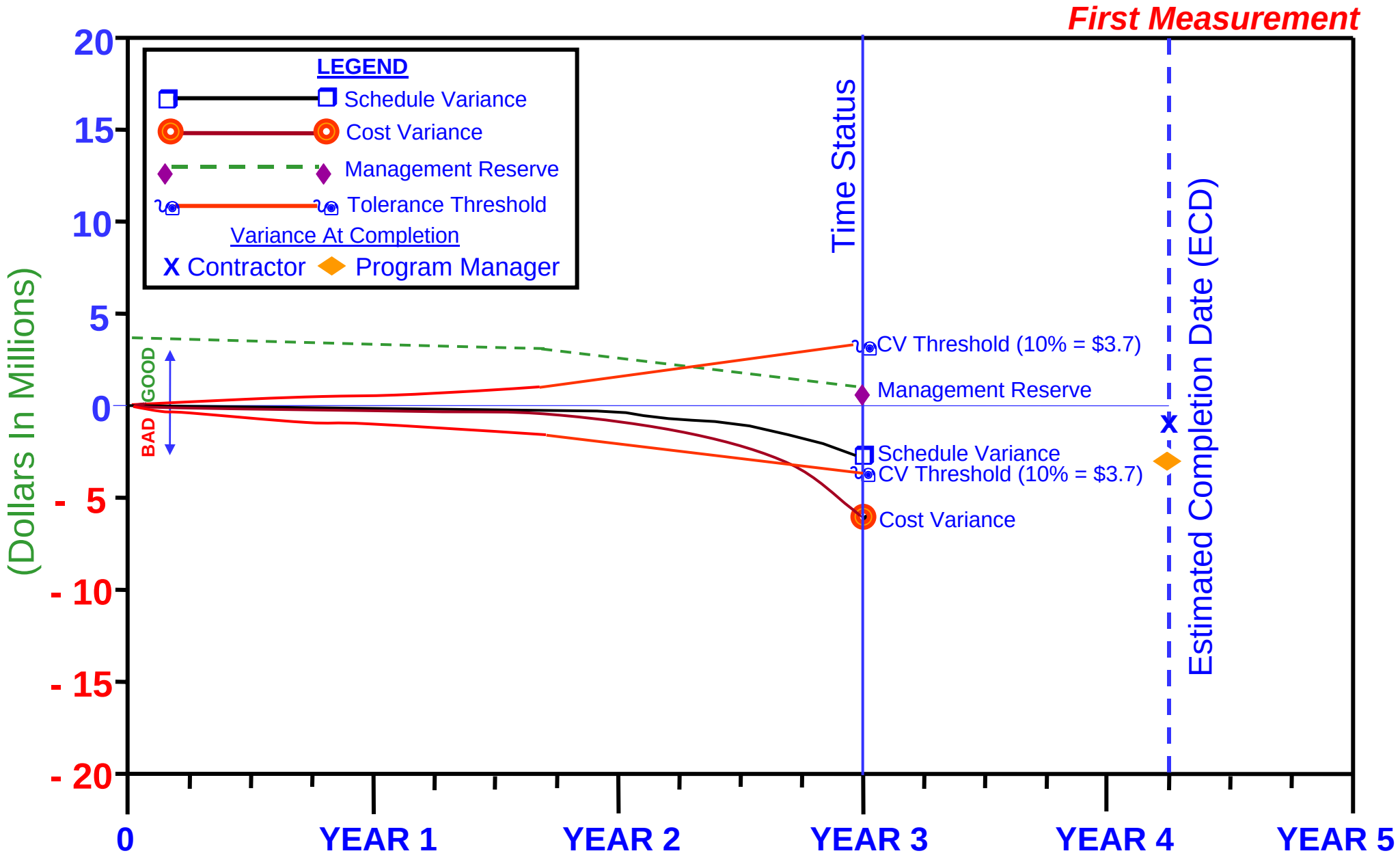
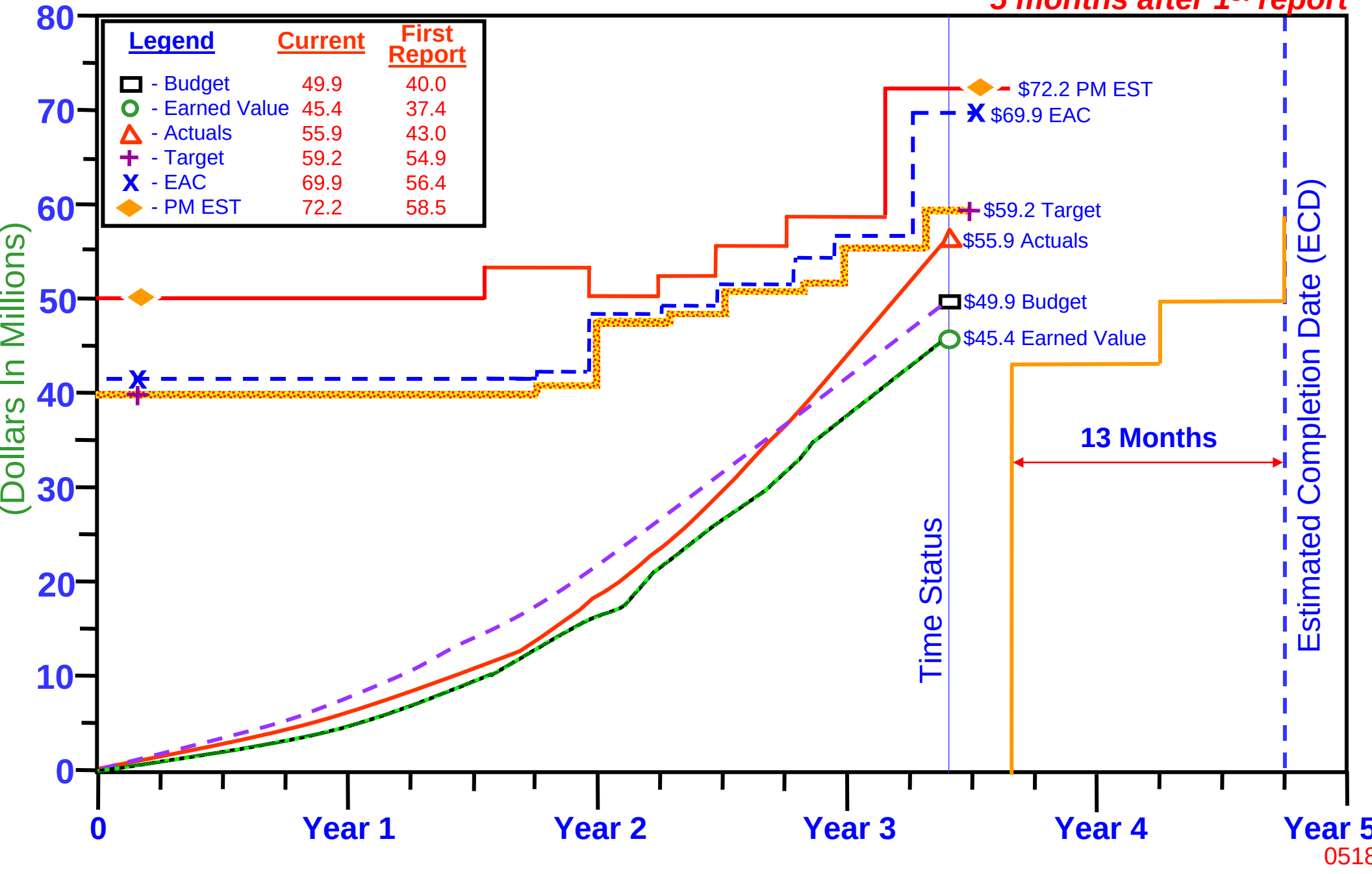
Cost/Schedule Variance Trends



0517

Contract Performance

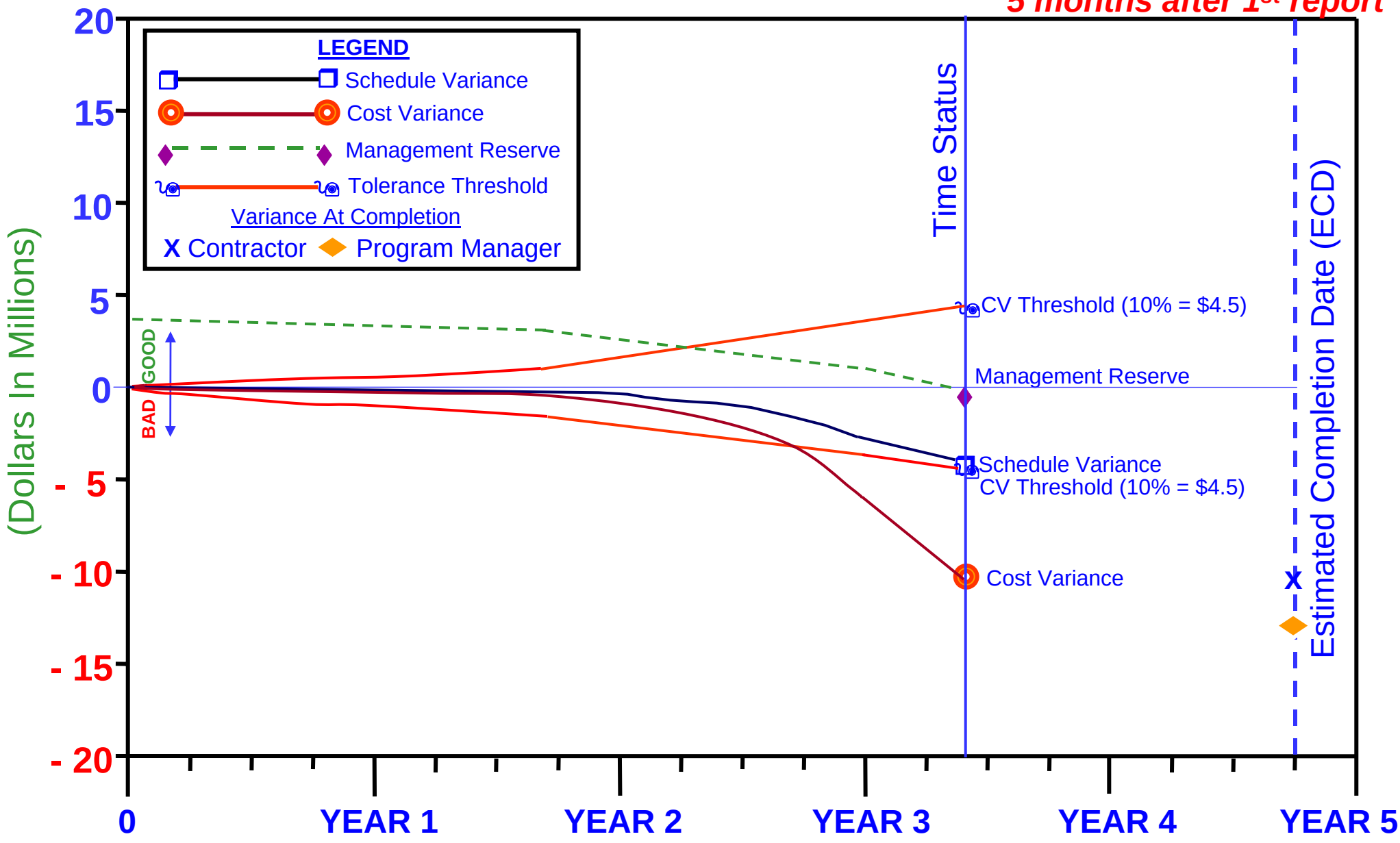
Second Measurement
5 months after 1st report



0518

Cost/Schedule Variance Trends

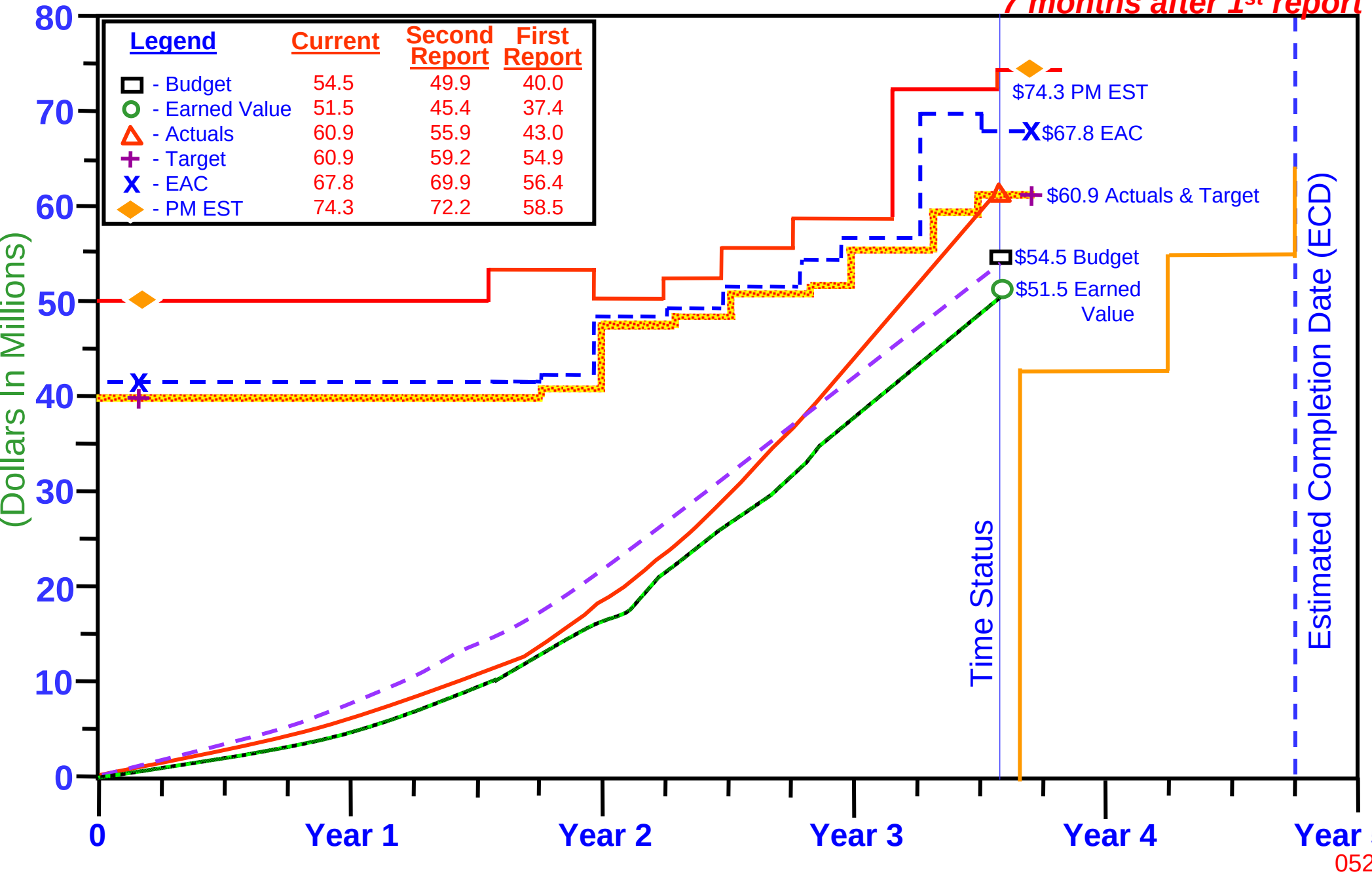
Second Measurement
5 months after 1st report



0519

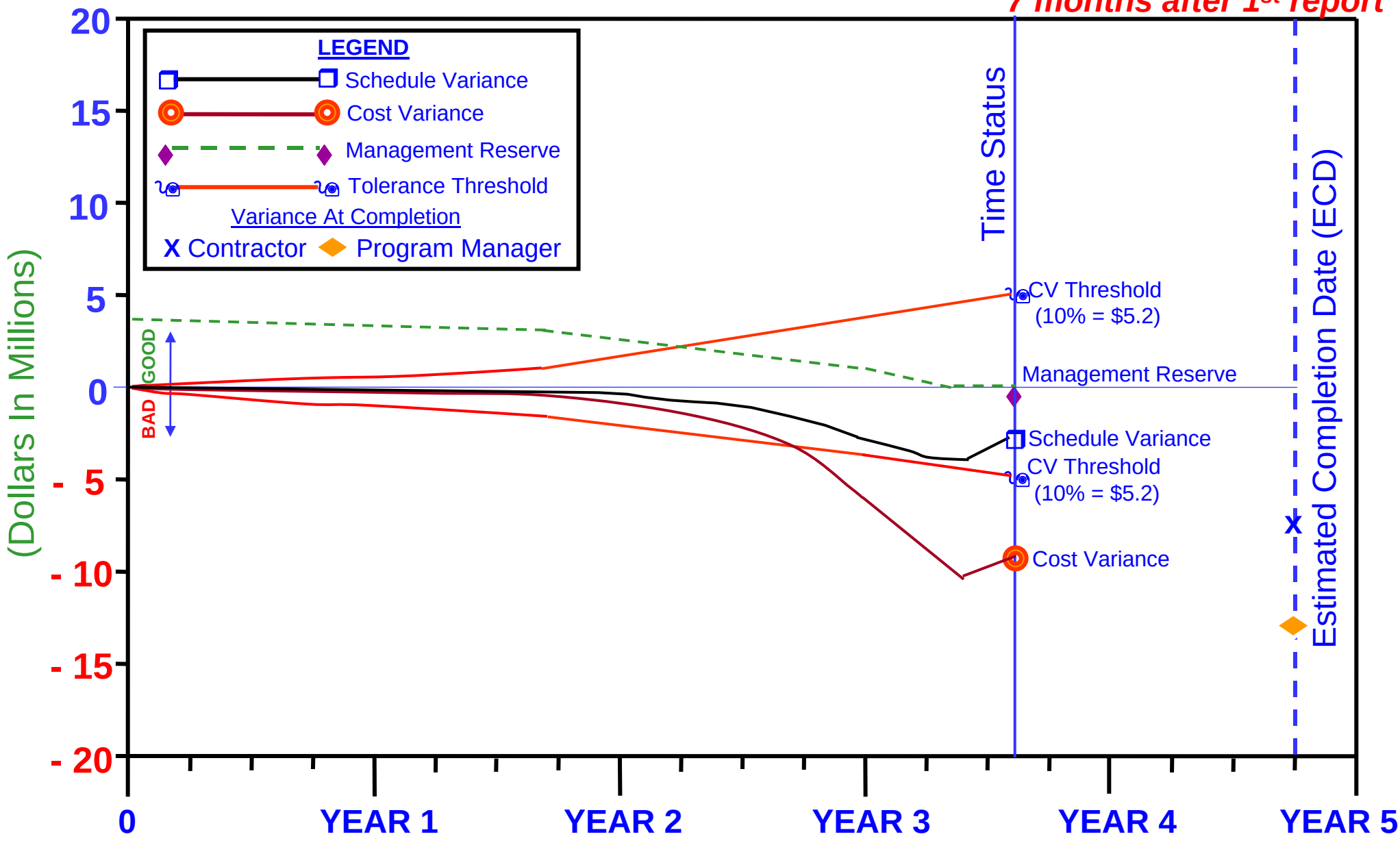
Contract Performance

Third Measurement
7 months after 1st report



0520

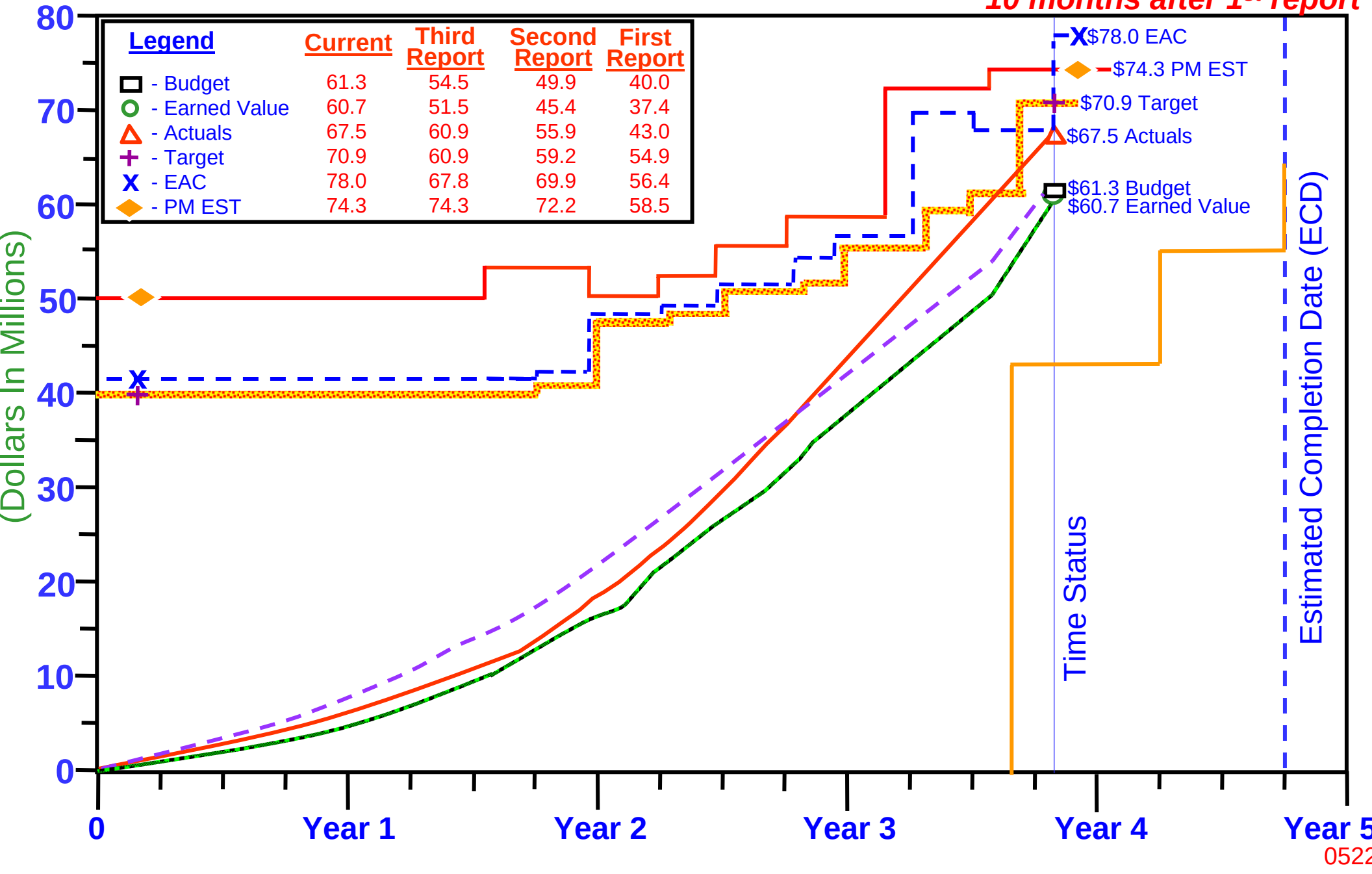
Cost/Schedule Variance Trends



052

Contract Performance

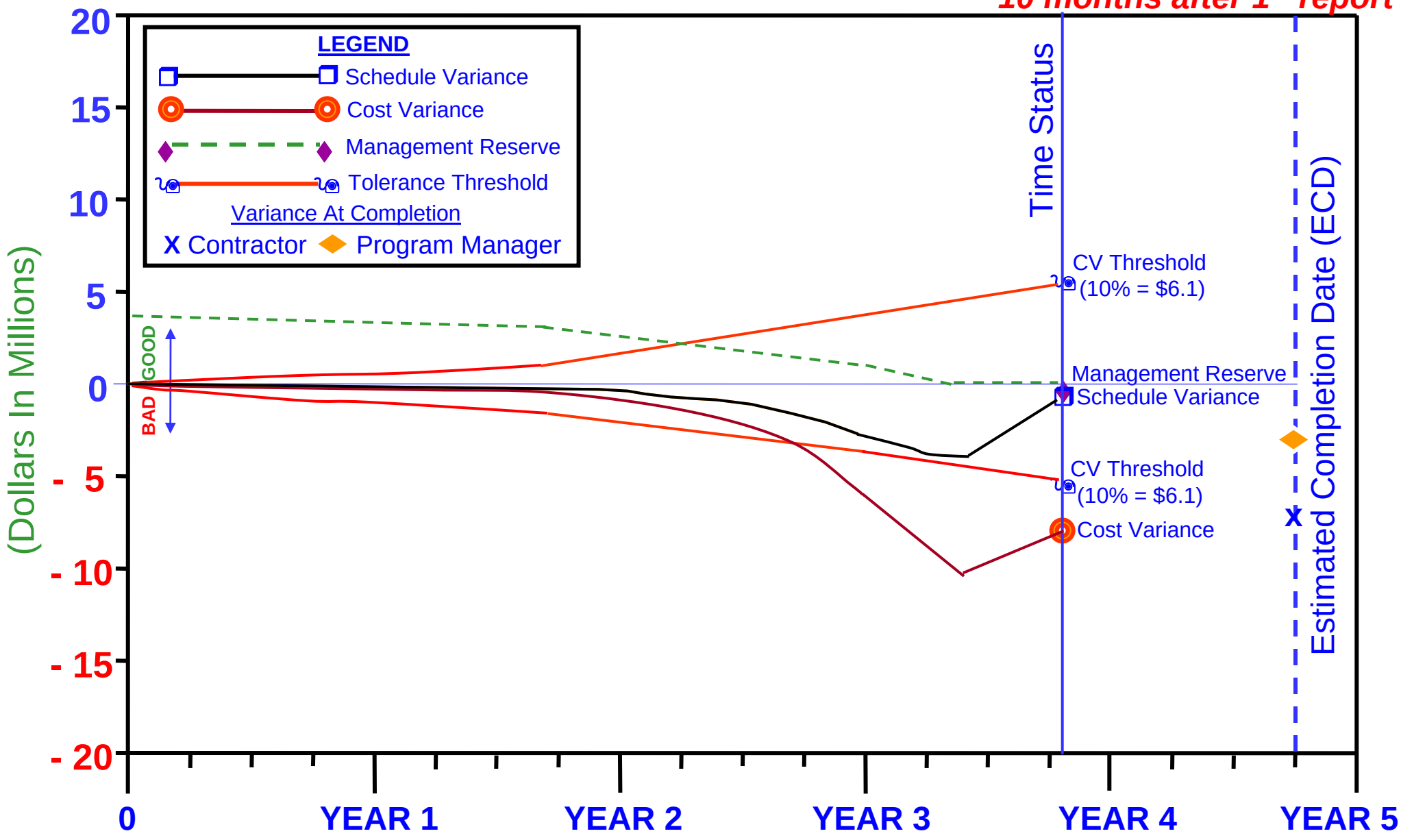
Fourth Measurement
10 months after 1st report



0522

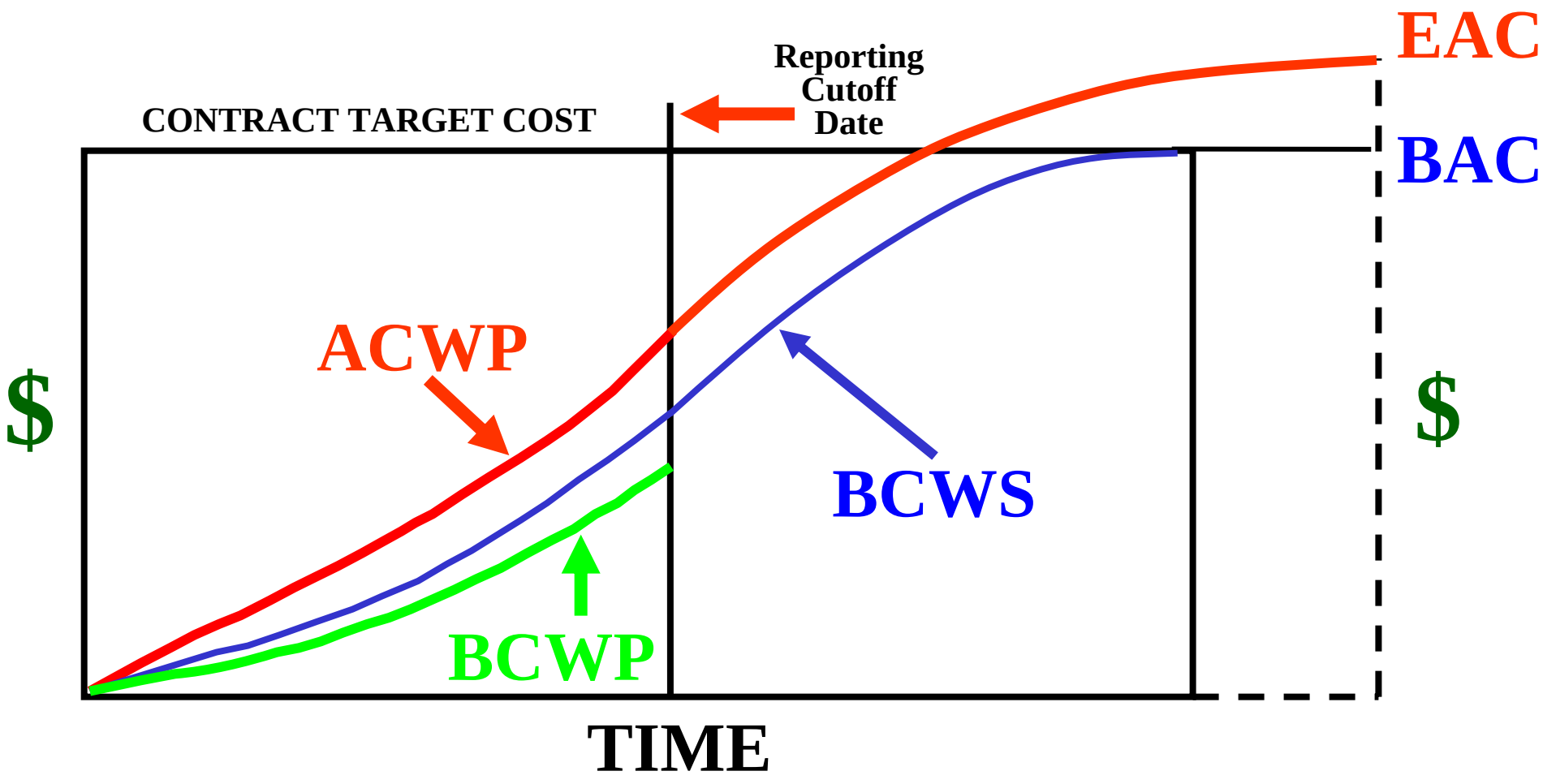
Cost/Schedule Variance Trends

Fourth Measurement
10 months after 1st report



0523

The End of Instruction



Thank You for your participation